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A new species of the *Lucanus boileaui* group from a high-altitude locality in Sichuan, China (Coleoptera: Lucanidae: Lucaninae)

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Abstract: A new species of *Lucanus* Scopoli, 1763 (Coleoptera: Lucanidae: Lucaninae), *L. luoi* **sp. nov.**, is described and illustrated from Sichuan, China. The species belongs to the *L. boileaui* group and is most similar to *L. jiaozishanus* Qi, He, Su & Song, 2023 from Yunnan. Diagnostic characters separating the two species are compared.

Keywords: Diagnosis, Lucanini, morphology, new species, taxonomy

中国四川高海拔地区黄胫深山锹甲种组一新种（鞘翅目：锹甲科：锹甲亚科）

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摘要：本文描述了一种产于中国四川的深山锹甲属新种——罗氏深山锹甲 *Lucanus luoi* **sp. nov.**（鞘翅目：锹甲科：锹甲亚科）。该新种属于黄胫深山锹甲种组 *L. boileaui* group 并且最似云南的轿子山深山锹甲 *L. jiaozishanus* Qi, He, Su & Song, 2023。本文比较了两者的鉴别特征。

关键词：鉴别，锹甲族，形态，新种，分类

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Introduction

Lucanus Scopoli, 1763 is the type genus of Lucanidae (Coleoptera) and is distributed in the Nearctic, Oriental and Palearctic Regions; however, its greatest diversity occurs in eastern Asia. Since the publication of the three landmark volumes *Stag beetles of China* by Huang & Chen (2010, 2013, 2017), 16 species of *Lucanus* have been added to the Chinese fauna (Wang & Zhu 2017; Wang & Zhan 2018; Wang & Ko 2018; Huang & Chen 2019, 2020; Adachi 2020; Lin 2021; Qi 2021; Bian & Zhan 2021; Zhan *et al*. 2022; Wang *et al*. 2023; Qi *et al*. 2023; Wang 2024; Lin *et al*. 2024; Li *et al*. 2025), and one synonymy was proposed by Zhou *et al*. (2022). Accordingly, the number of *Lucanus* species recorded from China before this study stands at 69 (excluding subspecies) (Huang & Chen 2010, 2013; Bartolozzi *et al*. 2016; Wang *et al*. 2023; Qi *et al*. 2023; Zhan & Young 2023; Wang 2024).

The *Lucanus boileaui* group is a small species group within the genus, comprising only five species and subspecies (Huang & Chen 2010; Qi *et al*. 2023; Xin *et al*. 2024; Lin *et al*. 2024): *L. boileaui* Planet, 1897, *L. jiaozishanus* Qi, He, Su & Song, 2023, *L. ludivinae ludivinae* Boucher, 1998, *L. ludivinae flavipes* Xin, He, Zhong & Qi, 2024, and *Lucanus qizhihaoi* Lin, Su, Xin & Song, 2024.

In early June 2025, a local collector from Liangshan Yi Autonomous Prefecture, Sichuan, posted a photograph of a large-sized, damaged, unidentified male specimen (Fig. 1), referable to the *L. boileaui* group, in a WeChat group. This specimen subsequently attracted the attention of various Chinese researchers and enthusiasts. Fortunately, we obtained this damaged specimen last year. Even more fortunately, nearly one year later we obtained five additional complete specimens of this species. Herein, we describe and illustrate it under the name *Lucanus luoi* **sp. nov.** Important morphological characters of the new species are illustrated, and a differential diagnosis from its closest relative, *L. jiaozishanus* Qi, He, Su & Song, 2023 from Yunnan Province, is provided.

Material and methods

Specimens were relaxed and softened in a HH-2 digital homoeothermic water bath at 44.4°C for 12 h, then transferred to distilled water for cleaning and dissection. To examine the genitalia of both sexes, the abdomens were detached and treated with a 10% potassium hydroxide solution for 12 h, then rinsed in distilled water to remove residual KOH and halt further bleaching. After examination, the dissected body parts were mounted on slides in Euparal Mounting Medium for future studies. Images were captured with a Canon MP-E 65 mm macro lens mounted on a Canon 5DsR. Images of the same subject at different focal planes were combined using Zerene Stacker 1.04. Adobe Photoshop CS6 was used for post-processing. The terminology used herein for external morphology and genitalia follows Holloway (2007) and Huang & Chen (2010, 2013, 2017). Measurements are given in millimetres (mm) and follow Wang & Zhou (2019).

Material examined in this study is deposited in the following collections: **MYNU—t**he invertebrate collection of Mianyang Normal University, Mianyang, China; **CTLH—**collection of Tian-Long He, Huainan, China; **CXYL—**collection of Xing-Yu Luo, Suzhou, China.

Taxonomy

Lucanus luoi sp. nov. 罗氏深山锹甲

https://zoobank.org/0464F758-EDA1-4376-B89E-9FBA391780F8

Figs 1; 2A–F; 3A; 4A–H; 5A–D; 6B, C; 7A–D

Type material: 5♂♂1♀. **Holotype:** ♂ (MYNU), **CHINA, Sichuan:** Liangshan Prefecture, Huidong County, Xinjie Town, Jiamashi Scenic Area [夹马石风景区], 3000 m, 4.VI.2026, local collector leg. **Paratypes:** 1♂1♀ (CTLH), same as holotype; 1♂ [damaged] (CTLH), same as holotype except 20.VIII.2025; 2♂♂ (CXYL), same as holotype except 12.VI.2026.

FIGURE 1. Head of *Lucanus luoi* **sp. nov.**, ♂, large size, paratype, dorsal view.

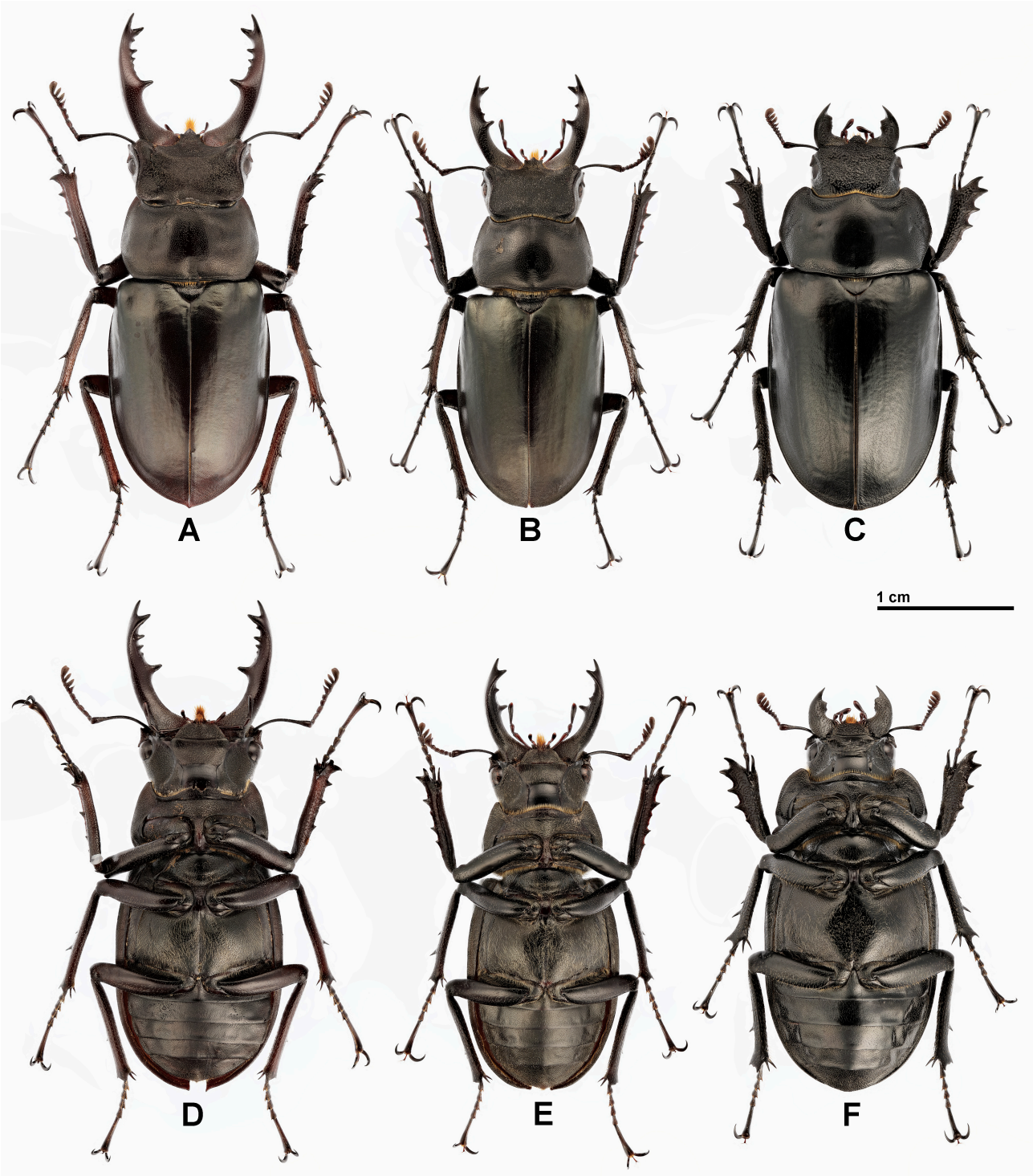

FIGURE 2. Habitus of *Lucanus luoi* **sp. nov.**: **A, D** ♂, medium size, holotype **B, E** ♂ small size, paratype **C, F** ♀, paratype. (**A–C** dorsal views **D–F** ventral views)

Distribution. China (Sichuan).

Etymology. This new species is dedicated to Mr. Xing-Yu Luo [罗星宇] (Suzhou, China), in appreciation of his generous assistance in obtaining the specimens. The name is a noun in the genitive case.

Description. Medium-sized male holotype (Figs 2A, D; 3A; 4C–H; 5A–C). Body 36.4 mm long, widest around anterior 2/7 of elytra. Lengths of particular parts (mm): head (5.5), mandible (10.0), pronotum (5.8), elytra (16.6); widths (mm): head (9.3), pronotum (10.1), elytra (12.0).

Habitus (Figs 2A, D). Body almost entirely blackish; elytra and appendages weakly tinged with dark brown. Body moderately lustrous. Dorsum nearly smooth, without visible pubescence; yellowish pubescence present on mouthparts, anterior and posterior margins of prothorax, and legs; pubescence on metaventrite longer and denser than elsewhere.

Head ca. 1.7 times as broad as long, broadest across ocular canthi; surface matt, finely punctate, interstices finely and irregularly granulose. Clypeolabrum lanceolate, anterior margin acute; clypeal ridge well developed, laterally produced into two strong teeth. Ocular canthus thin, anterior angle protruding anterolaterally, posterior angle protruding and exceeding lateral margin of eye. Preocular margin emarginate; postocular margin substraight. Anterior ridge weakly elevated; lateral ridges moderately elevated, moderately broad, apically rounded. Posterior margin widely concave. Mandible moderately long, ca.1.8 times as long as head, evenly incurved in dorsal view; inner margin with major inner tooth near midlength, preceded by 3–4 smaller teeth; major inner tooth slender, apex rounded, directed inward; apical fork with upper tooth longer and thinner than lower tooth. Antennal club with three pubescent antennomeres; antennomere 7 triangular at inner angle; antennomeres 8–10 lamellate. Mentum subtrapezoidal, strongly rugose, anterolateral angles rounded. Submentum inverted trapezoidal, microrugose. Gula wider than long, smooth.

Pronotum 1.7 times as wide as long, widest across posterior 4/9, and 1.1 times as wide as head. Anterior margin weakly protruded medially; lateral margins simply arcuate; posterior margin slightly bisinuate. Anterior angles acute, directed forwards; posterior angles obtusely rounded. Surface densely and finely punctate, interstices shagreened, and with median longitudinal depression rather shallow. Prosternal apophysis strong, distinctly convex ventrally at middle of posterior part, and truncate at posterior margin.

Scutellar shield linguiform, ca. 1.5 times as wide as long. Surface finely and roundly punctate, interstices microrugulate.

Elytra oval, almost smooth, 1.4 times as long as wide, widest around anterior 2/7, wider than pronotum. Humeri (Fig. 3A) almost rounded, inconspicuously protruding. Surface smooth, densely covered with rather fine punctures, interstices shagreened.

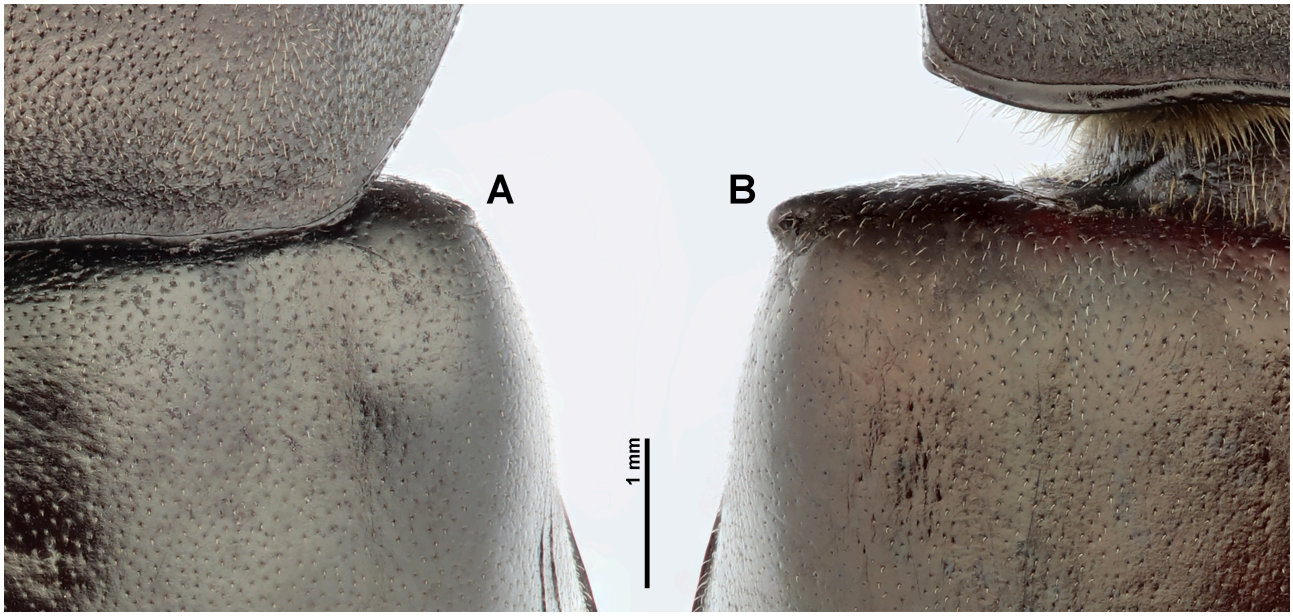

FIGURE 3. Male humeri of *Lucanus* spp., dorsal views: **A** *L. luoi* **sp. nov.**, medium size, holotype **B** *L. jiaozishanus* Qi, He, Su & Song, 2023, medium size.

Legs. Protibia with 3–4 subtriangular lateral teeth along outer margin; apex bifurcate, branches acute apically. Mesotibia with one tiny and two sharp lateral spines along outer margin. Metatibia with one tiny and one sharp lateral spines along outer margin.

Male terminalia. Abdominal sternite VII acutely protruded at middle of posterior margin. Abdominal tergite VIII (Fig. 4C) subhexagonal, lateral angles obscure, with subtriangular membranous area in middle of basal half; sternite VIII (Fig. 4B) transverse, with distinct subround membranous area in middle of basal part. Abdominal tergite IX (Fig. 4E) rounded at posterior margin, rather narrowly excavated at anterior margin, without lateral extensions (Fig. 4F); pleurite IX (Fig. 4E) narrowly separated dorsally; sternite IX (Fig. 4G) with wide membranous median stripe, gently arcuate in lateral view (Fig. 4H). Aedeagus (Fig. 5A) in ventral view ca. 2.1 times as long as wide; basal piece (Fig. 5A, B) gradually constricted anteriorly, ca. 1.6 times as long as parameres, lacking paired dorsal plates (Fig. 5B); ventral caudal plate (Fig. 5A) protruding anteriorly, with deep membranous median slit; paramere with narrow basal process (Fig. 5B), moderately upturned at round apex in lateral view (Fig. 5C); median lobe (Fig. 5A) subequal in length to parameres; flagellum (Fig. 5A–C) rather long and slender, ca. 3.0 times as long as aedeagus, apex not enlarged.

Small-sized male paratype (Figs 2B, E; 6B, C; 7A, B). Body 31.9 mm long. Lengths of particular parts (mm): head (4.4), mandible (7.3), pronotum (5.5), elytra (15.6); widths (mm): head (7.7), pronotum (8.9), elytra (10.9). The paratype consistent with holotype except for usual allometric differences, e.g., clypeolabrum shorter; mandible shorter; major inner tooth less developed, preceded by 1–2 smaller teeth; anterior and lateral ridges of head weaker.

Large-sized male paratype (Fig. 1). Lengths of particular parts (mm): head (11.0), mandible (10.5); widths (mm): head (10.8). The paratype consistent with holotype except for usual allometric differences, e.g., clypeolabrum longer; mandible longer; major inner tooth more pronounced, slenderly subtriangular, preceded by 3–4 smaller teeth; anterior and lateral ridges of head stronger.

Female paratype (Figs 2C, F; 4A, B; 5D; 7C, D). Body 29.8 mm long. Lengths of particular parts (mm): head (4.2), mandible (3.1), pronotum (6.3), elytra (17.1); widths (mm): head (6.9), pronotum (11.3), elytra (12.8).

Habitus (Figs 2C, F; 7C, D). Body almost entirely blackish. Body moderately lustrous. Dorsum nearly smooth, without visible pubescence; yellowish pubescence present on mouthparts, anterior and posterior margins of prothorax, and legs; pubescence on metaventrite longer and denser than elsewhere.

Head ca. 1.6 times as broad as long, broadest across ocular canthi; surface entirely covered with coarse punctures, interstices shagreened. Clypeolabrum small, subtrapezoidal, weakly emarginate at anterior margin. Ocular canthus well defined, anterior angle rounded, posterior angle protruding and exceeding lateral margin of eye. Preocular margin slightly emarginate. Postocular margin substraight. Anterior and lateral ridges absent. Anterior angles rounded. Mandibles ca. 3/4 length of head, asymmetric; both with weak dorsal teeth; left mandible with four feebly tuberculate teeth on projecting inner ridge; right mandible with two teeth on projecting inner ridge. Antennal club with three pubescent antennomeres; antennomere 7 slender, acute at inner angle; antennomeres 8–10 lamellate. Mentum semicircular, densely covered with coarse punctures, without anterolateral angles. Submentum inverted trapezoidal, sparsely covered with coarse punctures. Gula elongate, smooth.

Pronotum 1.8 times as wide as long, widest across lateral angles, and 1.6 times as wide as head. Lateral margin substraight just before and after lateral angle; posterior margin slightly bisinuate. Anterior angles subrounded; lateral angles rounded; posterior angles obtuse. Surface entirely covered with rather fine punctures, interstices shagreened.

Scutellar shield linguiform, ca. 1.8 times as wide as long. Surface finely and roundly punctate, interstices microrugulate.

Elytra 1.3 times as long as wide, widest around anterior 2/7, ca. 1.1 times as wide as pronotum. Surface smooth, entirely covered with rather fine punctures, interstices shagreened.

Legs. Protibia with one rather weak and two subtriangular lateral teeth along outer margin; apex bifurcate, basal branch much more expanded. Meso- and metatibia each with one tiny and two sharp lateral spines along outer

margin, respectively.

Female terminalia. Abdominal tergite VIII (Fig. 4A) semicircular, with thin membranous area in middle of basal half, without lateral angles; sternite VIII (Fig. 4B) with subround membranous area at center, connected posteriorly by a short transverse membranous strip. Hemisternite (Fig. 5D) elongate, apically rounded. Central conjunction of tergite IX protruding medially and rounded at tip. Accessory gland membranous, slender. Spermathecal duct short, subequal in length to spermatheca. Spermatheca (Fig. 5D) J-shaped, membranous. Spermathecal gland pyriform.

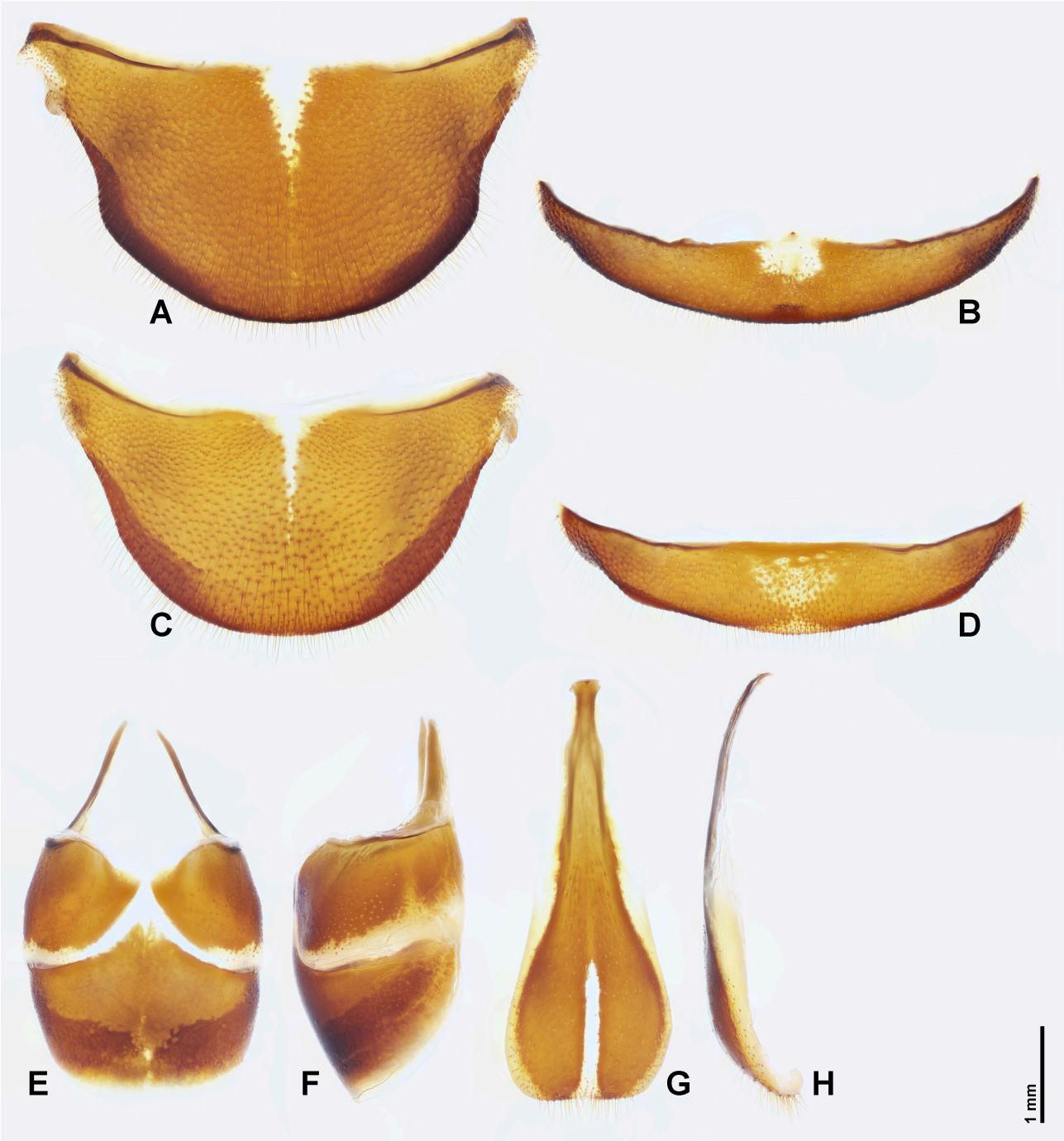

FIGURE 4. Abdominal segments VIII & IX of *Lucanus luoi* **sp. nov.**: **A** tergite VIII, ♀ **B** sternite VIII, ♀ **C** tergite VIII, ♂ **D** sternite VIII, ♂ **E, F** tergite and pleurite IX, ♂ **G, H** sternite IX, ♂. (**A, C, E** dorsal views **B, D, G** ventral views **F, H** lateral views)

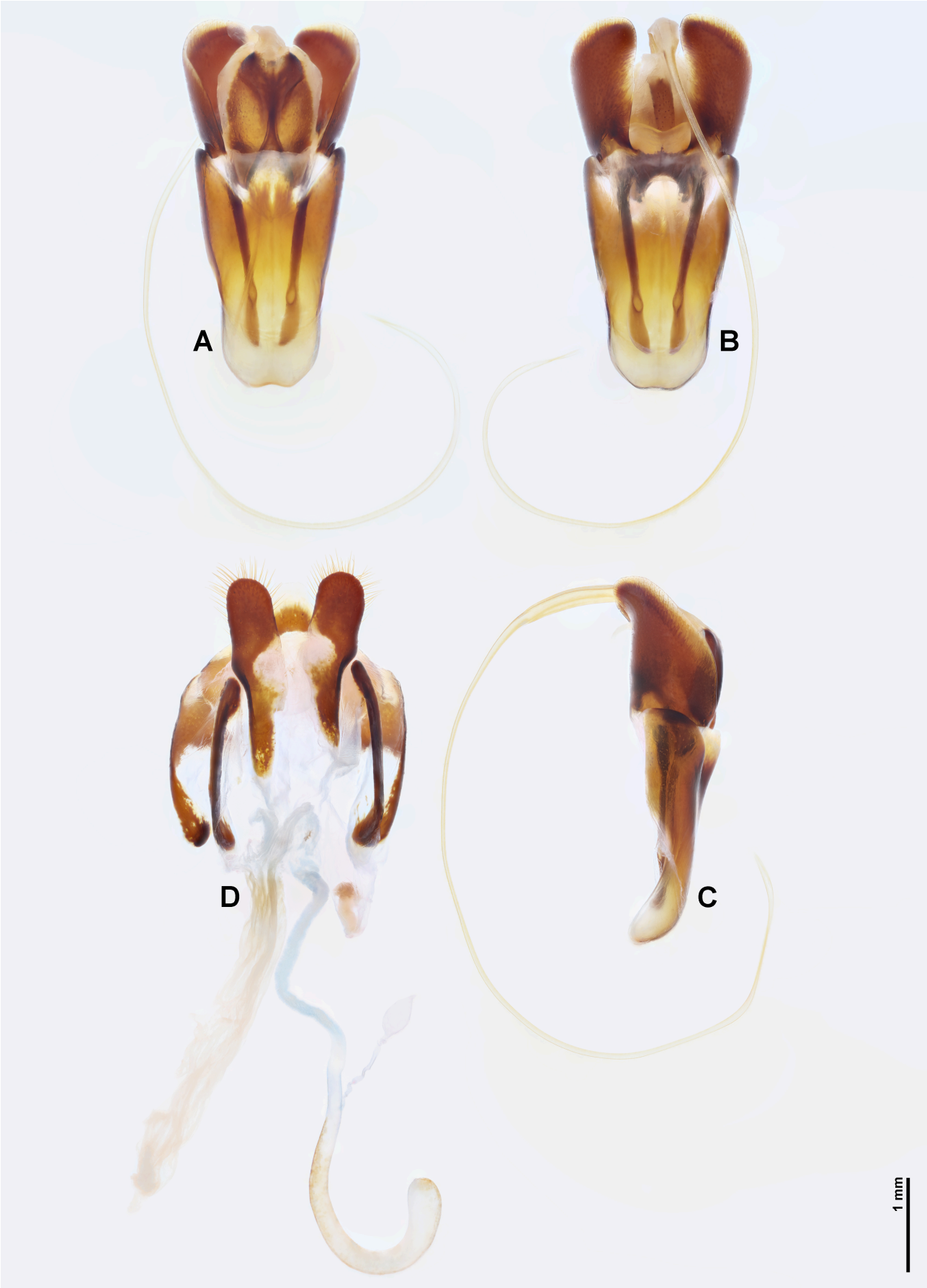

FIGURE 5. Genitalia of *Lucanus luoi* **sp. nov.**: **A–C** aedeagus, holotype **D** female genitalia, paratype. (**A, D** ventral views **B** dorsal view **C** lateral view)

Differential diagnosis. This new species belongs to the *Lucanus boileaui* group and most closely resembles *L. jiaozishanus* Qi, He, Su & Song, 2023 from Yunnan Province. It is distinguished from the latter by the following combination of characters (characters of *L. jiaozishanus* in parentheses):

In males of comparable size: body relatively larger (relatively smaller); elytra almost entirely blackish, weakly tinged with dark brown (elytra dark brown); clypeolabrum lanceolate, anterior margin acute (subhexagonal, anterior margin straight); clypeal ridge laterally produced into two strong teeth (two weak teeth); ocular canthus with anterior angle protruding anterolaterally (not protruding), posterior angle protruding and exceeding lateral margin of eye (not exceeding lateral margin of eye); mandibular major inner tooth relatively stronger (relatively weaker); mandibular apical fork more open (less open); pronotal lateral margins simply arcuate (more protrudent at widest part); humeri almost rounded, inconspicuously protruding (distinctly protruding (Fig. 3B)); abdominal sternite VIII with distinct subround membranous area in middle of basal part (with indistinct transverse membranous area in middle of basal part); ventral caudal plate of aedeagus with deep membranous median slit (without membranous median slit); flagellum ca. 3.0 times as long as aedeagus (ca. 2.0 times).

In females: ocular canthus clearly defined, anterior angle rounded, posterior angle protruding and exceeding lateral margin of eye (both anterior and posterior angles not defined and within eye margin); right mandible with two teeth on projecting inner ridge (one tooth); hemisternite elongate (short); spermathecal gland pyriform (oval).

Remarks. All specimens of *L. luoi* **sp. nov.** were collected in forests at Jiamashi Scenic Area, at an altitude of 3000 m (Fig. 6A). A living small-sized male is shown in Figs 6B, C and 7A, B, and a living female in Fig. 7C, D.

FIGURE 6. Field observations of *Lucanus luoi* **sp. nov.** at Jiamashi Scenic Area of Sichuan, China: **A** natural habitat, alt. 3000 m **B, C** small-sized living male, paratype. (**B** dorsal view **C** dorsolateral view) (© local collector)

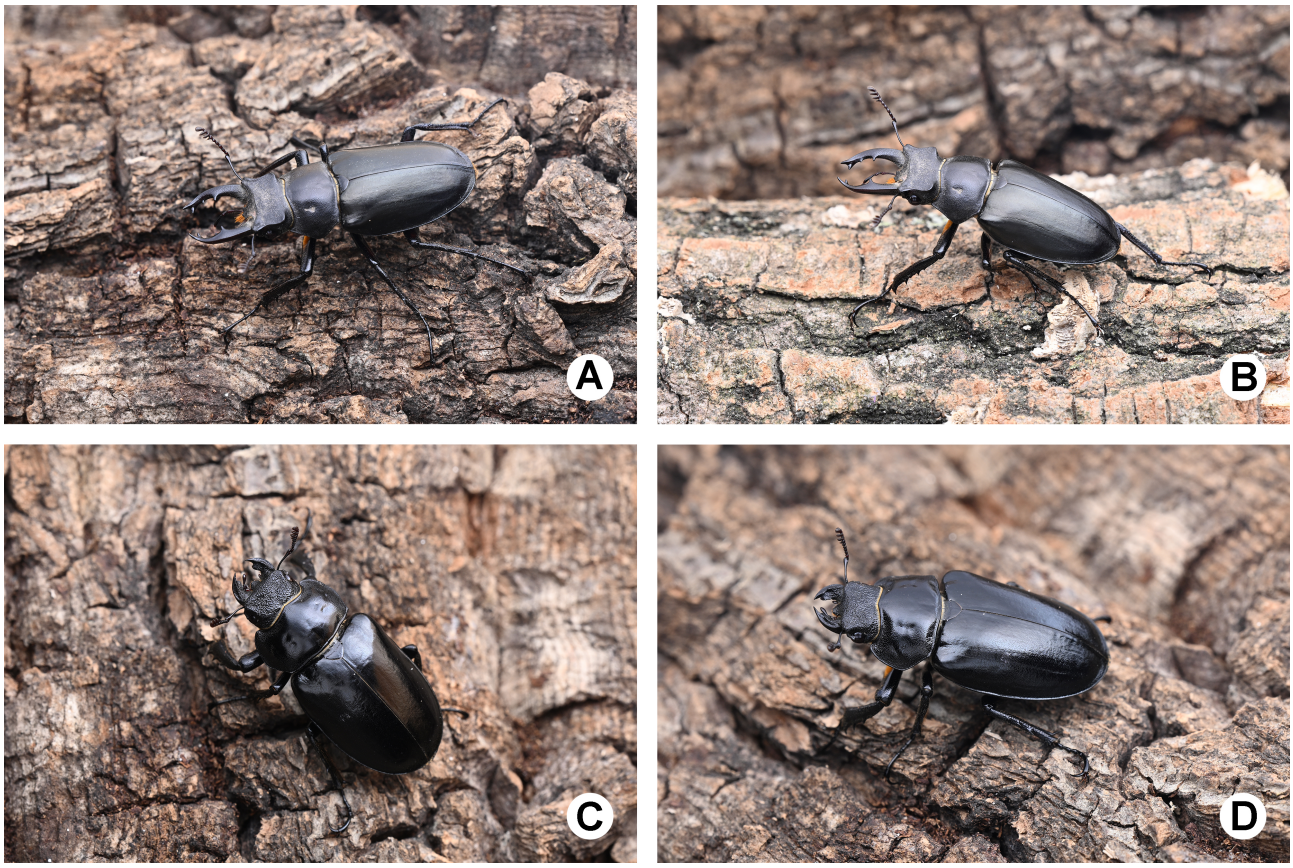

FIGURE 7. Living *Lucanus luoi* **sp. nov.**, dorsolateral views: **A, B** ♂, small size, paratype **C, D** ♀, paratype. (© Hao Xu)

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